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MAJA VALLES AND THE CHRYSE OUTFLOW COMPLEX SITES. J. W. Rice, Department of Geography, Arizona State University, Tempe AZ 85287, USA.

Maja Valles Region: This candidate landing site is located at 19°N, 53.5°W near the mouth of a major outflow channel, Maja Valles, and two "valley network" channel systems, Maumee and Vedra Valles. This region has been mapped in detail by Rice and De Hon and is in press as a USGS 1:500,000 scale geologic map. The advantages to this site are the following: Two distinct channel forms (outflow and dendritic valley network) in one location. These channels were formed by different processes. The outflow channels are believed to have formed by catastrophic release of water and the valley networks by surface runoff and or sapping. The ideal landing site, if it could be pinpointed, would be on the fan delta complex located at the terminus of the three channels (Maja, Maumee, and Vedra Valles). The fan delta complex would be a fairly smooth surface with shallow slopes.

Water was impounded behind the wrinkle ridge system, Xanthe Scopulus, forming a temporal lake. This paleolake bed would also present itself as a safe landing site, perhaps similar to playas. Once the wrinkle ridges were breached the water flowed northeastward in the direction of the Viking 1 lander, some 350 km away.

Objectives to be analyzed in this region are (1) origin and paleohydrology of outflow and valley network channels, (2) fan delta complex composition (this deposit located in this area is one of the few deposits identified at the mouths of any channels on the planet), and (3) analysis of any paleolake sediments (carbonates, evaporites). Another advantage to this area will be any blocks and boulders that were plucked out and carried along the 1600-km course of Maja Valles. These samples would provide a virtual grab bag of lithologies. For example, the oldest mappable rock unit (Nb, Noachian basement material) and the Hesperian ridged plains (Hr) are cut by Maja Valles before it empties into Chryse. It can be argued that we will not know their exact location, which is true, but it will provide us with information about the variety of rock types on Mars by only landing in one site. Other questions to be investigated in the area are the origin of wrinkle ridges by viewing ridge walls that were incised by the outflow, streamlined islands/bars; whether they are erosional or depositional, and if the location permits view channel wall stratigraphy, fan delta stratigraphy, and perhaps send the rover up a channel mouth near the end of its mission.

This site is below the 0-km elevation datum, within the latitude restrictions (19°N), and all the objectives stated above are within the 150-km landing error ellipse. This region is also imaged at resolutions of 40–50 m/p.

The Chryse Outflow Complex Region (Ares, Tiu, Mawrth, Simud, and Shalbatana Valles): The overall philosophy and objectives described above for the Maja Valles region apply here as well. The primary objectives here would be outflow channel dynamics (paleohydrology) of five different channel systems. One question to be answered might be whether all outflow channels are of the same origin and type. They are probably all somewhat different in terms of duration, age, source, and perhaps even origin. The grab-bag philosophy of various rock types being deposited near channel mouths would apply here also. The site is located at 15°N, 35°W. However, the longitudinal coordinate can be relaxed or slid farther to either side of 35°W. Sliding the ellipse farther to the east would

allow investigations of Mawrth Valles. The region near the mouth of Mawrth Valles would be of interest because this area contains material that appears to have been dissected, thus exposing the stratigraphy of what may possibly be deltaic sediments.

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MARTE VALLES SITE. J. W. Rice, Department of Geography, Arizona State University, Tempe AZ 85287, USA.

This site is located at 16°N, 177°W on the flood plains of Marte Valles, which is perhaps the youngest channel system on Mars. However, the coordinates for the landing site are flexible. Moving the site more to the southwest would allow investigations of possible lacustrine sediments. The channel extends for about 3000 km from southeastern Elysium Planitia into western Amazonis Planitia. This system appears to originate within the knobby cratered material around Cerberus Rupes, a set of en echelon fractures that extend for more than 1000 km. Crater counts indicate that this system is Amazonian in age. This channel may have also acted as a spillway between paleolakes located in Elysium and Amazonis Planitia. The young age of this channel warrants investigation because of climatic implications for fluvial activity in recent geologic time. The paucity of craters makes this an excellent site in terms of safety requirements. Detailed work by Tanaka and Scott indicate that embayed craters larger than 1 km diameter appear embayed by the channeled plains unit, suggesting that it is only tens of meters thick. This material contributed to the resurfacing of the northern lowlands of the planet. Some of the objectives stated previously for the Maja Valles Region would also apply to this site (grab bag of rock types, etc.). This site is below the 0-km datum, located at 16°N, and has the young channeled plains, bars, terraces, and streamlined albedo patterns located within the 150-km landing error ellipse. Resolution coverage in some areas is as high as 13 m/p.

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ALPHA PROTON X-RAY SPECTROMETER. R. Rieder¹, H. Wänke¹, and T. Economou², ¹Max-Planck-Institut für Chemie, Mainz, Germany, ²University of Chicago, Chicago IL 60637, USA.

Mars Pathfinder will carry an alpha-proton X-ray spectrometer (APX) for the determination of the elemental chemical composition of martian rocks and soils. The instrument will measure the concentration of all major and some minor elements, including C, N, and O, at levels above typically 1%.

The method employed consists of bombarding a sample 50 mm in diameter with alpha particles from a radioactive source (50 mCi of ²⁴⁴Cm) and measuring (1) backscattered alpha particles (Rutherford backscatter = RBS mode), (2) protons from A(,p)B reactions (proton mode) and (3) characteristic X-rays emitted from the sample (X-ray mode). In RBS mode all elements with atomic mass greater than four are registered, thus permitting normalization of results to 100% concentration. This feature permits accurate quantitative analysis independent (within limits) of the actual measurement geometry. Data obtained from proton and X-ray modes are used to enhance selectivity of the RBS mode for the rock-forming elements Mg, Al, and Si and for heavier elements (K and Ca, Fe-group):

Resolving power in the RBS mode is determined by the energy spread of the alpha source and the range of backscatter angles observed by the detectors. These parameters in turn determine the number of backscattered alpha particles per unit time. In the present design the use of proton and X-ray data permits us to trade selectivity for sensitivity.

The instrument has a long standing space heritage, going back to the days of Surveyors V, VI, and VII (1968–1969) and Phobos (1988). The present design is the result of an endeavor to reduce mass and power consumption (Surveyor: 10 kg/10 W; Phobos: 2.7 kg/2.5 W; this instrument: 0.6 kg/0.3 W); four instruments are scheduled to fly on the Russian Mars '94 mission: two on penetrators (without X-ray mode) and two on small stations (including the X-ray mode, using "room temperature" mercuric iodide detectors provided by the University of Chicago). These are currently being calibrated and prepared for integration.

The instrument for Mars Pathfinder will be a duplicate of the instruments for the Mars '94 small stations but with minor changes. It consists of a sensor head, incorporating the alpha sources, a telescope of silicon detectors (35 and 700 m thick) for the detection of alpha particles and protons and a mercuric iodide X-ray detector with preamplifier, and an electronics box (80 × 70 × 60 mm) containing a microcontroller-based multichannel spectrometer. The sensor head will be mounted on the rear of the Mars Pathfinder Microrover on a deployment mechanism that permits placement of the sensor in contact with sample surfaces inclined at any angle from horizontal to vertical, thus permitting measurement of the composition of soil and rock sample. The electronic box will be contained in the microrover's "warm" container and will communicate with the microrover control system through a standard RS 232 serial interface.

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ATMOSPHERE STRUCTURE AND METEOROLOGY INSTRUMENT FOR MARS PATHFINDER. A. Seiff, San Jose State University Foundation, Mail Stop 245-1, NASA Ames Research Center, Moffett Field CA 94035, USA.

The MESUR Science Definition Team recommended that all MESUR probes, including Pathfinder, carry an ASI/MET experiment, in order that no opportunity be lost to characterize the atmosphere of Mars in passing through it. The experiment was thus included on Pathfinder from the start (February 1992), but on an essentially noninterference basis: It was to make no unusual demands on the spacecraft. A Science Advisory Team appointed by NASA Headquarters in September 1993 first met on November 3 to initiate formal science participation, and the level of activity has since been high. The instrument passed its Preliminary Design Review on February 28.

The structure of the atmosphere is measured during entry and descent; meteorological parameters, pressure, temperature, and wind velocity are collected during the mission lifetime after landing. The structure experiment has two phases. During high-speed entry, from 160 km to near 8 km (where the parachute is deployed), accelerometers define the density structure. In the parachute descent, atmospheric pressure and temperature are measured until airbags are deployed ~150 m above touchdown. Entry phase pres-

ures are obtained by integrating measured densities assuming hydrostatic equilibrium (the technique used on the Viking and Pioneer Venus missions and to be used on the Galileo Probe); the equation of state then yields temperatures. The sensors employed are guidance-quality accelerometers, Tavis and Vaisalla pressure sensors, and chromel-constantan thermocouples with platinum resistance thermometers at their cold junctions.

Constraints imposed do not allow the descent phase sensors to project outside the lander envelope, nor are the accelerometers in an optimum configuration about the center of gravity. The Science Advisory Team (SAT) is exploring the effects of these limitations, but they should not prevent the acquisition of valuable data.

The meteorology measurements were originally limited to pressure and temperature, but were extended to include winds because of the apparent simplicity of the hardware. The measurement resolution will be 256× better than that of Viking, which was resolution limited. Temperature measurements at three elevations above the surface, and wind measurements at two heights (if affordable within available lander resources), will define profiles not available from the Viking instrument. Rapid sampling for 5 min/hr will define both diurnal and seasonal variations and turbulence. Consideration is being given to sampling over selected 1-hr intervals for better definition of fluctuations. Pressure sensors are shared with the ASI. Temperature sensors are chromel-constantan thermocouples of 75-μm wire diameter. Wind is sensed from the convective heat loss of heated wires. Sensors have been designed and evaluated analytically. They will be evaluated experimentally and refined if necessary from tests at Mars surface conditions in the Mars Wind Tunnel at NASA Ames Research Center (operated by Arizona State University).

To move them away from thermal influence of the lander electronics, the temperature and baseline wind sensor are mounted on the whip antenna, which communicates with the rover, about 1 m away from the lander core. The wind sensor and primary temperature sensors are about 0.5 m above the surface; two other temperature sensors are 0.25 m and 0.125 m above the surface. The second wind sensor is proposed to be mounted on the low-gain antenna, about 1 m above the surface. Pressure sensors are in the Warm Electronics Box in the lander core. The temperature profiles will differentiate between stable and convective near-surface conditions, and define atmospheric heating rate. Wind profiles will likewise discriminate stable from unstable conditions, and define near-surface shear, as well as provide a valuable input to boundary layer models.

The greatest concern we have for the descent phase results from the restriction against external deployment of the temperature sensor (for reasons of air bag safety). The sensor must sample atmosphere flowing through the lander rather than around it, at velocities well below the descent velocity. This slows sensor response time, e.g., to ~4 s if the internal velocity (yet to be established) is 1 m/s. For the entry phase, the major problem is correction of measured accelerations for angular inputs at off-center of gravity locations. For landed meteorology, the major concern is the design of the wind sensor to work sensitively at extremely low power levels in the low-density atmosphere and define wind directions. Problems of thermal contamination are also inevitably present.